

THE RELATION OF THE SAND DUNE FORMATION ON
THE SOUTH WEST COAST OF AFRICA TO THE
LOCAL WIND CURRENTS.

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THE prevailing winds on this coast from the mouth of the Orange River to Walfish Bay are as follows :—

First, in the summer months, namely from November to April, from early morning to midday North to North-west, from midday light South-west, increasing in force till from 7 p.m. to midnight, then dying away gradually and coming round to North before day-break. North to North-west wind brings the fog-bank on shore and sometimes carries it far inland, South to South-east carries it out to sea.

Secondly, winter months, May to October, mornings calm with light North-west to North, fog on land, mid-day to midnight light South-west dying away to calm. Occasional strong northerly wind for from three to four days in succession and once at least in each month for a period of from two to eight days, hot and very dry East wind frequently blowing a full gale. This wind generally comes on about 2 a.m., increasing in force till 10 to 11 a.m., dying away to calm in the afternoon ; it carries clouds of fine dust, consisting, for the most part, of tiny grains of quartz and flakes of mica.

From Angra Pequena to Walfish Bay the coast is lined by a belt of sand hills, varying between five and fifteen miles in width and from 50 to 300 feet high. At the back of these hills is a desert strip from thirty to eighty miles wide, devoid of vegetation and covered by nodules of white quartz and pinkish white felspar. This gravel results from the decomposition of the granite, gneiss and mica schist which form the predominant rocks of the district. As the rocks decompose, the softer constituents, that is to say the mica and the smaller particles of quartz and felspar, are, owing to the want of rain to consolidate them, carried away by the winds, leaving the larger modules covering the surface, which is consequently white and glaring. These fragments present the appearance of being water-worn, but are

really only polished by the constant attrition of the smaller particles blowing against them. Radiation from this glistening surface and its bordering sand hills is necessarily very great, and as soon as the sun rises the air becoming heated begins to ascend. This action increases as the day advances and the heat becomes greater; and during the summer months, when the air over the sea is much colder and denser than that of the interior behind the desert, a current from the ocean is introduced to fill the vacuum caused by the ascending air. This action, increasing as the radiation increases, and decreasing again as the sun sinks, is the cause of the rise and fall of the South-west wind so prevalent in summer. Again, as all the rain in these parts comes in the form of afternoon thunderstorms from the North-east and falls from November to May, it follows, and actual observation verifies the theory, that these South-west winds day by day drive back the approaching rain clouds, which may be seen banked up and discharging their contents to the eastward where the power of the South-west becomes less as the distance from its generating causes, the desert and the sea, increases. Thus a reciprocal action is in force; the want of rain to check denudation, by the winds, of the decomposing rocks and to promote the growth of vegetation causes the desert, the radiation from which creates the South-west current; while this same South-west wind, by driving back the rain continues the conditions which result in its own formation; consequently there is but little hope of any improvement in the condition of this waste, which is also so saline as to render afforestation or cultivation next to impossible; it will, therefore, probably remain a desert as long as the present geological conditions remain unchanged.

When, as is the case at intervals during the winter months of May to October, the evaporation after the rainy season generates sufficient cold to reduce the atmospheric temperature of the country behind the desert to a point lower than that of the sea, a reverse action is set up and wind from the East rushes in to fill the daily vacuum caused by the rise of the air over the heated desert; and when, as also happens at intervals, the night temperature of the interior falls below the freezing point, coincidently with clear weather near the coast, this wind increases to a powerful gale. Cold at the eastern fringe of the desert it becomes warmer as it passes over the heated surface, till at the coast it is a scorching sirocco. It carries with it enormous quantities of dust resulting from the disintegration

of the desert surface as already described ; and as it meets the resistance of the colder and denser stratum of air from the sea, also struggling towards the vacuum, its force gradually becomes exhausted, and, as it dies away, it deposits its suspended particles of sand and mica, partly on the coast and partly in the sea. Some of that which falls into the sea is carried along by the current, which runs strongly to the North, until a submerged reef of rocks is met with as at Sandwich Harbour and Angra Pequena, when a portion of the sand is arrested, the bank thus formed eventually rising above the surface ; and thus are formed the sand spits, always trending northwards, by which the bays of Sandwich Harbour and Walfish Bay are protected from Southerly and Westerly winds.

Having thus shewn the effects of the sand dunes and desert on the local winds, we will now consider the relation of these currents to the progressive motion of the sand dunes from North to South. Dr. F. M. Stapff, of Weissensee near Berlin, has, in his report to the German Colonial Society in 1886, concluded that the sand dunes of the South-west coast were formed under the sea and afterwards raised above its level. This is an entirely erroneous conclusion, resulting from cursory and superficial observation, as I will proceed to shew. In the first place the enormous quantities of sand, brought to the coast by the East wind and partially deposited near the shore as already explained, are quite sufficient to account for the extent of the deposit. Secondly, there is a total absence of shells or other organic remains of marine life in the sand of the dunes. Again the sand hills are ever advancing to the North. This is caused by the alternate action of the East wind and the South-west, which is diagonal to the direction of the former, and thus the sand being first pushed to the West and then back to the North-east, gradually extends itself to the North.

In this way the sand hills have, in the course of ages, been advanced to the North extending the desert as they extended, until they reached the Kinsib river. They have completely choked and obliterated the lower courses of several minor rivers, such as the Choondap and others, which now disappear under the eastern edge of the sand dunes. The Kinsib river still sends down sufficient water in years of plentiful rain in the interior to clear its bed of the sand dunes formed in it in the intervals and thus keeps a road from Walfish Bay, where it debouches, open to the interior. The river ran to the sea in 1856, 1864, 1881, and 1885, and the long intervals between gave the sand hills time to

cross it, and form smaller hills as far as the Swakop river. This latter however runs into the sea every year, and scours its bed clean of the sands blown into it during the preceding dry season. Consequently we find no sand dunes north of this river; and also as we travel northwards and parallel to the coast we find the desert strip steadily narrows until in the Kaoko veldt, about 150 miles north of the Swakop, we reach a district with a steady annual rainfall and grass right down to the sea beach. The struggle which has taken place between the sand and the Kinsib river is beautifully exemplified between Sandwich Harbour and Walfish Bay. There is no doubt that this river formerly debouched at the former port and has gradually been pushed north for thirty miles, until it empties itself at Walfish Bay. This is clearly proved by the old silt bed, with root and stems of reeds still undecomposed, appearing everywhere *under* and between the sand hills, while fresh water is obtainable at a depth of a foot or two, anywhere above high water mark, between Sandwich Harbour and Walfish Bay and nowhere else along the coast; and the spaces between the sand dunes are covered with water grasses and reeds growing in the silt and nourished by the same fresh water. And in the spaces between the sand hills near Walfish Bay are still to be seen the deeply impressed foot-prints of elephants and rhinoceroses, in the sunbaked silt, thus shewing that prior to the advance of the sand, considerable vegetation, on which those animals subsisted, must have covered the present waste.

I think I have conclusively shewn the great effect which these sand hills have had upon the meteorological conditions of the South-west Coast, and it only remains to point out the lesson to be derived, viz., the great importance of arresting the formation of similar deposits in their early stage by planting them with grasses and shrubs calculated to bind the sand and thus preventing them from extending until they become past control.

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